# DC VOLTAGE STANDARD
# AND
# NULL METER
# MODEL 301

ELECTRONICS FOR COMMUNICATION • MEASUREMENT • CONTROL

KINTEL

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# DC VOLTAGE STANDARD
# AND
# NULL METER
# MODEL 301

## TECHNICAL MANUAL
## 15X-5

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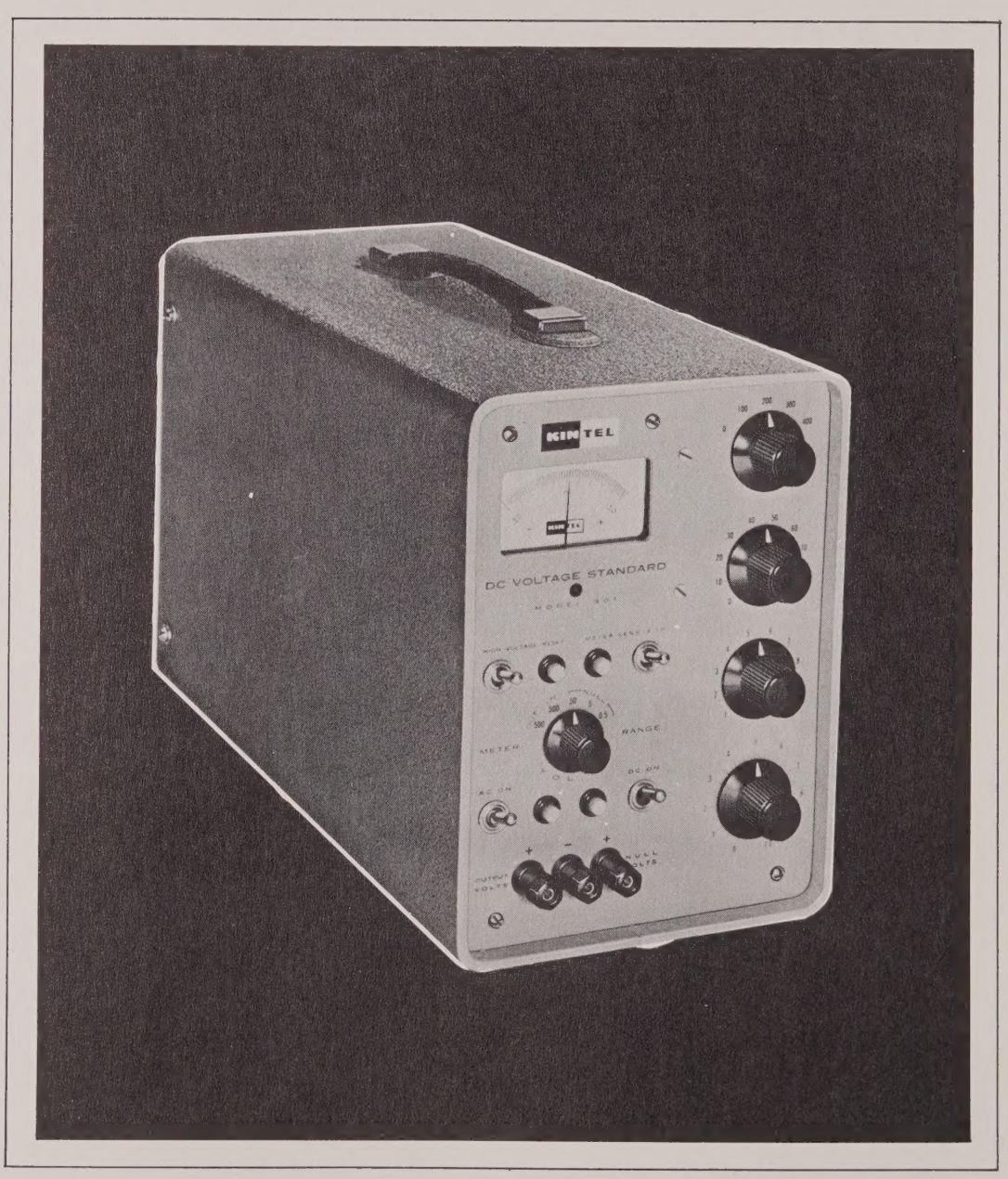


KIN TEL MODEL 301 DC VOLTAGE
STANDARD AND NULL METER

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# SECTION 1

# GENERAL

## 1.1 DESCRIPTION

### 1.1.1 Design Capabilities

The KIN TEL Model 301 is an extremely compact, variable DC-standard and null-meter. Direct-reading, calibrated dials provide instant voltage-selection with standard-cell accuracy. A chopper-stabilized circuit constantly compares the output with an internal standard-cell to provide this accuracy and stability.

As a null voltmeter, the unit measures voltages from 1 v to 501 v through 4 decaded null-meter ranges (50 v to 50 mv full scale). A sensitivity switch multiplies any range by a factor of 10.

The meter can also be used to read input voltage or the output voltage of the supply.

### 1.1.2 Applications

The Model 301 is a versatile precision reference for calibration and measurement laboratories. Its unique design makes it a criterion among units used in production calibration of precision measuring instruments and power supplies.

It serves as a secondary voltage standard, a secondary voltmeter standard, or a transducer supply with equal precision and dependability. It is invaluable in the design of DC amplifiers and complex electronic circuitry, in transistor testing, or as a computer reference. It also has a very definite place in the field of vacuum-tube research and production.

## 1.2 SPECIFICATIONS

| | |
|---|---|
| Output Voltage: . . . . . | 1 to 501 volts, variable in steps of 100 v, 10 v and 1 v, and variable between 1-volt steps with a stable potentiometer |
| Output Current: . . . . . | 0 - 20 millamperes |
| Long-Time Stability: . . . . . | ± 100 PPM |
| Short-Time Stability (several hours): . . . . . | ± 50 PPM |

| | |
|---|---|
| Calibration Accuracy: . . . . . | ± 0.02% at settings in excess of 10 volts, or 2 mv at settings of 10 volts or less. This applies only with potentiometer in the fully-CCW position |
| Output Hum and Noise: . . . . . | Less than 100 μv RMS |
| Load Regulation: . . . . . | 0.002% at settings in excess of 10 volts; 200 μv at settings of 10 volts or less, no load to full load |
| Line Regulation: . . . . . | 0.002% for a ± 10% line-voltage change |
| Response to Transient Load: . . . . . | 0.2 ms |
| DC Output Impedance: . . . . . | Less than 0.01 ohms |
| Meter Range, Full Scale: . . . . . | *DC Output ± 500<br>*DC Input ± 500<br>*Null ± 50, 5, 0.5<br><br>*All above sensitivities are multiplied by 10 by actuating a momentary switch. |
| Meter Sensitivity: . . . . . | 2 mv per minor division (25-0-25 μa) |
| Failure Protection: . . . . . | A protective circuit is employed which automatically turns off the instrument in the event that the output voltage rises to a point 30 to 50% above the set voltage |
| Floating Output: . . . . . | DC-leakage resistance from output terminals to case is more than 250 megohms<br><br>AC-leakage current from output terminals to case is less than 8 μa RMS |

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

# SECTION 2

# OPERATION

## 2.1 PRECAUTIONS

### 2.1.1 Temperature Considerations

The KIN TEL Model 301 employs as a reference a standard cell which is sensitive to temperature extremes. Essentially, ambient temperatures should be restricted to a range of 4° C (39° F) to 40° C (104° F).

### 2.1.2 Physical Positioning Considerations

Standard cells are sensitive to extreme changes in physical position. After shipment, or after the instrument has been physically inverted during servicing, or after any type of severe handling, it may require up to eight hours of stabilization time. For this reason, upon initial receipt of the instrument, and after lengthy storage, a warm-up period of several hours is advised.

## 2.2 USE AS A DC STANDARD

### 2.2.1 Turn-On Procedure

Figure 2-1 shows the front panel of the Model 301R (Rackmount). Cabinet model is illustrated on frontispiece.

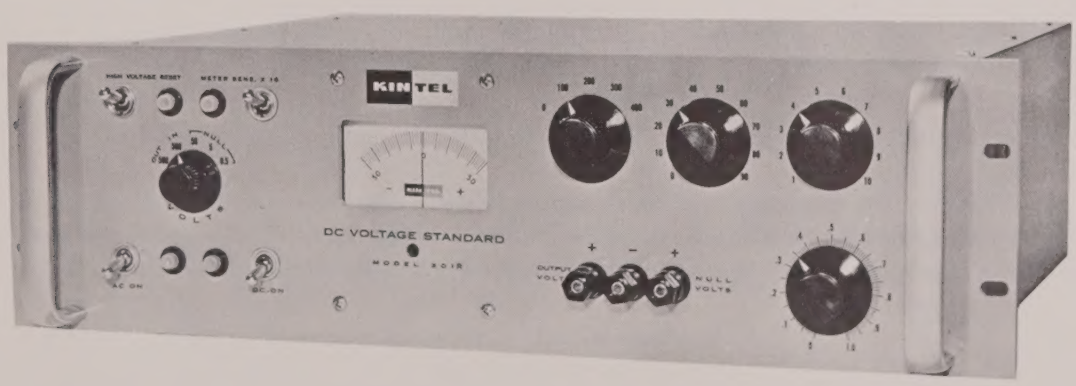



FIGURE 2-1

Ascertain that both "AC-ON" and "DC-ON" switches are in the off position. Connect the line-cord plug to a source of 115-volt, 60-cycle current.

Set the meter-range switch ("VOLTS") to "OUT" and the attenuator switches to a total of 100 volts (100's dial at "0", 10's dial at "90", 1's dial at "9" and .1's dial at "1.0") (or 100's dial at "0", 10's dial at "90", 1's dial at "10" and .1's dial at "0").

The AC switch may now be turned on. This will cause the "AC-ON" indicator to light and the blower fan to operate, but power will not be immediately available from the unit.

When the electronic circuits have warmed up (approximately 10-15 seconds), the "HIGH VOLTAGE RESET" indicator will light. Depress the "HIGH VOLTAGE RESET" switch, and the reset light will be extinguished; at the same time, the meter will register 100 volts on the positive side of the mirrored scale.

Depress the "DC-ON" switch. An output of 100 volts is now available at the output terminals "OUTPUT VOLTS +" and "-".

By use of the attenuator settings available, all output voltages from 1 volt to 501 volts may be supplied at the output terminals and metered as described for the 100-volt setting.

### 2.2.2 "METER SENS. X 10" Switch

Set the attenuator to 50 volts and depress the "METER SENS.X10" switch. When this switch is closed, the sensitivity indicator will light and the meter should indicate the output as full scale (500 volts).

This use can be made of the sensitivity-times-ten factor on all voltage ranges.

## 2.3 USE AS A NULL INDICATOR

### 2.3.1 Turn-On Procedure

Ascertain that both "AC-ON" and "DC-ON" switches are in the off position. Connect the line-cord plug to a source of 115-volt, 60-cycle current.

Set the meter-range switch ("VOLTS") to the "IN" position.

Now connect the unknown voltage to the input terminals "+NULL VOLTS" and "-". The meter will indicate the amount of applied voltage within 4%. To approach the absolute value of the input voltage, it must be nulled with the voltage of the standard supply:

Set the attenuator to the approximate voltage as read by the meter.

Set the "DC-ON" switch to the "ON" position, and the meter-range switch to "NULL 50". The meter should now indicate the approximate difference between the input voltage and the attenuator setting.

Vary the attenuator as necessary to reduce the difference voltage to a center-scale reading. As the center-scale reading is approached, increase the meter sensitivity by use of the "METER SENS. X 10" switch, nulling the voltage as necessary with the attenuator, until absolute center of the scale is reached.

The voltage which is now indicated by the attenuator settings is the exact voltage being applied to the input terminals.

# SECTION 3

# CIRCUIT DESCRIPTION

## 3.1 GENERAL CIRCUIT DESCRIPTION

### 3.1.1 Basic Block Diagram

Figure 3-1 is a basic block diagram of the power supply section of the KIN TEL Model 301.

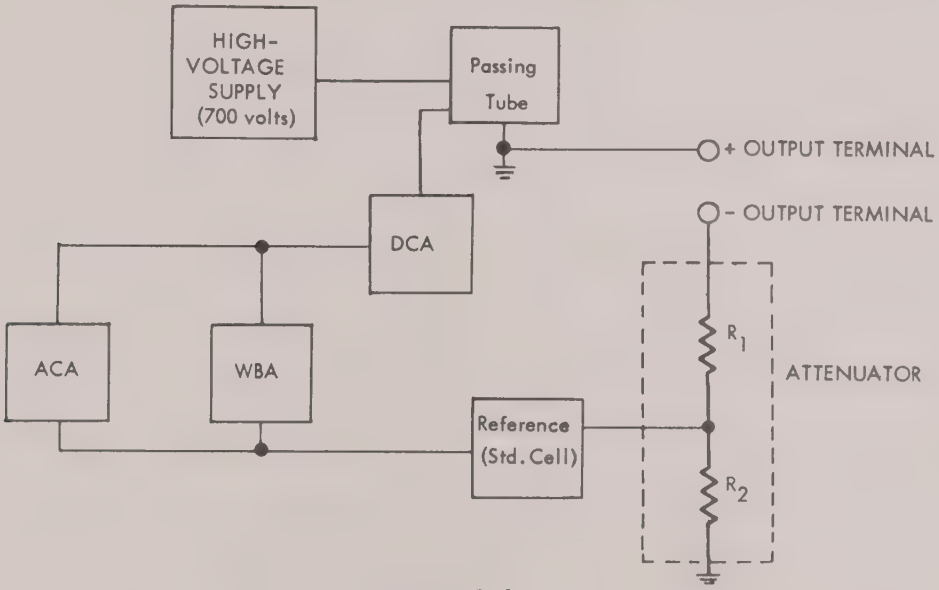



FIGURE 3-1

It can be seen that the positive-output terminal of the supply is connected directly to circuit common. Thus the negative end of the supply will vary with respect to the positive end whenever the output voltage is varied.

The high-voltage supply is capable of delivering 700 volts to the passing tube which, in turn, may deliver as much as 500 volts to the output of the instrument.

When the attenuator is set to deliver the maximum output, R1 in Figure 3-1 will consist of 500K, while $R_2$ will always remain 1K. The total output at this setting is then 501 volts. The 1 volt developed across $R_2$ is compared to the reference voltage. This reference voltage is precisely 1 volt, which is obtained from a standard cell in conjunction with a precision divider and a mercury cell

The voltage resulting from the comparison of the reference to the attenuator fraction is fed to the chopper amplifier (ACA) and the wide-band amplifier (WBA). The outputs of these stages are summed and applied to the DC amplifier (DCA). After further amplification in the DCA, the voltage is applied to the passing tube, and controls its plate resistance.

If a total of approximately 700 volts is available from the high-voltage supply, and the output is set to 501 volts, then there must be approximately 200-volts drop across the passing tube.

If the attenuator setting is now decreased to 400 volts, the voltage across $R_2$ will increase, and a difference between $E_{R2}$ and the reference will result. This difference will appear at the inputs of the ACA and the WBA, and after amplification in these sections will be further amplified by the DCA and applied as bias to the passing-tube grid, thus increasing its plate resistance.

As a result, the drop across the passing tube will increase, and the voltage between the output terminals will decrease proportionately. This, in turn, will decrease the voltage across $R_2$, resulting in a balance between the reference and $E_{R2}$, and thus no further signal will be fed to the inputs of the ACA and the WBA.

### 3.1.2 Detailed Block Diagram

Figure 3-2 is a block diagram which details the configuration of the circuits, incorporating the ACA-output demodulator, protective circuits and null indicator. The signal paths are indicated, as are the low-voltage supplies and the DC distribution.

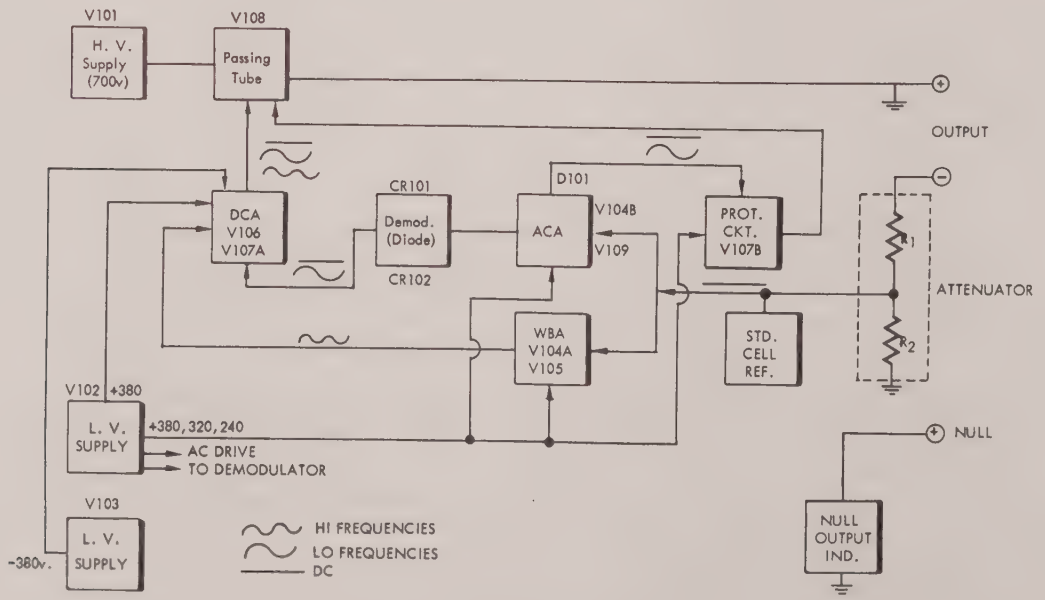



FIGURE 3-2

As previously described, the standard-cell reference is compared to the voltage developed across $R_2$, and the difference is applied to the ACA and WBA.

The output of the ACA is DC and low-frequency information superimposed on the 60-cycle chopper output. The ACA output is converted to DC and low-frequency information only, due to the action of the driven-diode demodulator. The WBA, meanwhile, is amplifying the higher frequencies of the "difference signal".

As indicated in Figure 3-2, the outputs of the demodulator and the WBA are applied to the DCA, but not at the same point. The reason for this will be explained in Section 3.2.

Two low-voltage supplies are shown in Figure 3-2. The first of these makes available +380 volts, +320 volts, and +240 volts. These voltages are distributed to the DCA, ACA, WBA and over-voltage protective circuits. In addition, AC supplied from this source furnishes drive voltage for the driven-diode demodulator.

The second low-voltage supply provides a -380 volts which is applied to the DCA. Thus the DCA is operated, as shown, between +380 volts and -380 volts.

The DCA output, as described in Section 3.1.1, determines the amount of voltage which the high-voltage supply will deliver by controlling the grid bias of the passing tube.

The over-voltage protective circuit opens the plate circuit of the passing tube whenever there is an excessive overload at the output or whenever the output voltage exceeds the voltage set by the attenuator.

The null-output indicator consists of 25-0-25 μa meter movement and the appropriate multipliers.

## 3.2 DETAILED CIRCUIT DESCRIPTION

Reference is made to Schematic Diagram D8015100, appendixed to this manual.

### 3.2.1 Standard-Cell Reference

The standard-cell reference consists of BT103, BT104, R179, R180 and R181. The resistors and potentiometer are arranged to furnish a bucking voltage of 20 millivolts which opposes the nominal standard-cell output, with a resultant voltage of 1.0 volts. This 1.0 volts is used, in turn, as a reference.

The voltage developed across R302 is compared to the 1-volt reference, and any variation results in an output which is applied to the ACA and the WBA. Relay K103 must be energized (by energizing relay K101) to provide a signal path to the ACA. K101 is energized by closing switch S102. See Figure 3-3 for relay sequence.

### 3.2.2 Chopper Amplifier (ACA)

The ACA consists of D101, V104B, V109 and associated circuitry.

The signal resulting from the comparison between the standard-cell reference and the voltage developed across R302 is applied through R154 and an R-C network (R155 and C131) and through R156 to pin 3 of chopper D101. R159 limits surge current in the chopper.

CR105 serves to limit the input voltage to the chopper to a maximum of +0.3 volts. This is necessary to prevent the opening of the output circuit by the over-voltage protective circuit, V109B (See Section 3.2.6).

The voltage applied to pin 3 of the chopper is converted to pulsating DC at a 60-cycle rate. When this pulsating DC is applied to C132, the AC component is coupled to grid-pin 7 of V104B, where it is amplified and coupled from plate-pin 6 through C134 to grid pin 2 of V109A. The amplified signal at plate-pin 3 of V109A is coupled through C137 and R168 to grid pin 7 of V109B where it is further amplified and coupled through C114 to the driven-diode demodulator.

R157 and C133 determine chopper waveform characteristics; C138 sets the normal high-frequency limit of the ACA.

BT102, a mercury cell, provides bias to V104B and V109, as well as to V104A in the wideband amplifier.

#### 3.2.2.1 Driven-Diode Demodulator

The demodulator circuit in the chopper amplifier consists of CR101, CR102, and associated circuitry. AC to these diodes is applied from the +380-volt low-voltage supply (a secondary winding of T101) through R124 and R125. The AC voltage across this winding is applied in the proper phase (with respect to the driving voltage of chopper D101) to provide electronic-switching action which demodulates the output of the ACA.

The high-frequency component derived from the output of the diode demodulator is coupled through R123 to the grid of V106, first stage in the WBA. The low-frequency component of the demodulator output is developed across a network consisting of R137, R138, R139, and a capacitor (C119) which bypasses all high-frequency components, leaving only DC and very low-frequency excursions. These are coupled through R134 to the control grid (pin 7) of the pentode section of V106.

### 3.2.3 Wide-Band Amplifier (WBA)

The wide-band amplifier receives the high-frequency component of the signal found at the junction of R179 and R150 through capacitor C105 and resistor R109. A network connected between R109 and grid-pin 2 of V104A (consisting of C106 and R110 in parallel) provides high-frequency compensation. The lower-frequency limit of this amplifier is

approximately 150 cycles.

The amplified high-frequency signal is coupled from plate-pin 1 of V104A through C109 and another high-frequency network (consisting of C111 and R115) to grid-pin 1 of V105. Included in the grid circuit of V105 is a network (R114, C111 and 1102) which provides feedback from the plate of V109A through C136. This feedback serves to improve the response time of the WBA. BT101 furnishes bias voltage for the grid of this stage. The signal applied to grid-pin 1 of V105 is amplified and coupled through C113 to grid-pin 2 of V106, first stage in the DCA.

### 3.2.4 DC Amplifier (DCA)

V106, a cathode-follower, is operated between -380 volts and chassis ground. The signal developed across R128 is common to the cathode of the pentode section. This signal is amplified and fed back from plate-pin 9 through R122 and C110 to plate-pin 1 of V104A to increase the stability of the WBA.

The low-frequency component from the driven-diode demodulator which is applied to control-grid pin 7 of V106B is amplified and directly coupled to grid-pin 5 of the passing tube. The amplified signal at the plate of V106B is also coupled through C123 to the cathode(pin1) of V107A. A signal is also coupled from plate-pin 5 of V105 through C122 to grid-pin 2 of V107A. This stage functions as a low-impedance driver for the passing tube at high frequencies.

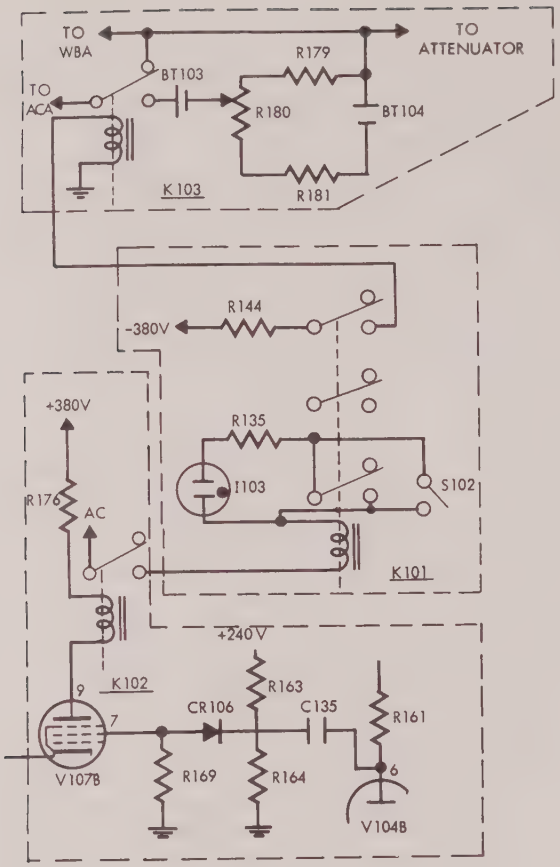
### 3.2.5 Passing Tube

The DC and low-frequency signal at grid-pin 5 of passing tube V108 varies the plate resistance of this tube. Thus an increase in the reference voltage developed across R302 will cause the plate resistance of V108 to increase. Since V108 is connected in series between the positive output terminal and the positive side of the high-voltage supply, the voltage drop across V108 will increase, resulting in a decrease in the available output voltage. A decrease in the reference voltage developed across R302 will cause a corresponding decrease in the plate resistance of V108 and an increase in the available output voltage.

### 3.2.6 Over-Voltage Protective Circuit

The signal at plate-pin 6 of V104B which is coupled to V109A is also coupled through C135 to the junction of divider R163-R164. The approximate +2.5 volts DC at this divider junction is applied to the cathode of CR106 as a holding voltage which renders CR106 nonconductive unless the voltage coupled from plate-pin 6 of V104B exceeds -2.5 volts.

It can be seen that if a large enough negative voltage is applied to pin 3 of the chopper, the resulting AC voltage, after amplification by V104B, will present a signal having sufficient peak-to-peak amplitude to cause the negative excursions to overcome the holding voltage of +2.5 volts and allow CR106 to conduct. Conductance of CR106 decreases conduction of V107B, which results in the opening of K102 contacts. When K102 opens, K101 and K103 are de-energized and, consequently, the plate circuit opens in passing-tube V108. See Figure 3-3 for relay sequence.




RELAY SEQUENCE

① As heater current is applied, V107B conducts current through K102.

② K102 becomes energized, thus applying AC to one side of K101 drive coil and lighting HV Reset indicator.

③ When HV Reset Switch S102 is closed, K101 drive coil is energized and remains so with its self-holding contacts after S102 is allowed to open.

④ The closing of one set of K101 contacts applies a negative DC voltage to K103 drive coil.

⑤ The energizing of K103 applies the standard-cell voltage to the ACA.

⑥ If the signal at V104B plate contains negative excursions of great enough amplitude (See Section 3.2.6), CR106 conduction cuts off V107B, and K102 is thus de-energized.

⑦ Opening of K102 de-energizes K101.

⑧ Opening of K101 de-energizes K103, the opening of which eliminates the standard-cell input to the ACA.

FIGURE 3-3

It would appear that the application of a positive voltage to chopper-pin 3 would have the same effect, since the peak-to-peak amplitude of the resultant AC signal would contain negative excursions of proportionate value. This would mean that when reset-switch S102 is depressed, the subsequent energizing of K103 would apply +1.0 volt to the chopper, with the result that the protective circuit would function and the reset relay would open almost the moment it had been closed.

For this reason, CR105 has been incorporated in such a manner that the application of a positive voltage greater than +0.3 volts will cause the diode to conduct, thus limiting the signal to the chopper.

To protect against filament failure in the first ACA stage, the pulses across the 4-ohm resistor in the filament-rectifier circuit are filtered and applied as forward bias to Q101. In the event of filament burn-out, the load on the rectifiers is reduced, resulting in a reduced bias voltage of Q101, allowing the cathode of V107B to rise, which de-energizes protective-relay K102.

### 3.2.7 Metering Circuit

The null-output indicator is a 25-0-25 μa movement, which is in series with R182, R183, R184 and R185. It is shunted by CR107 and CR108, two M500 diodes which serve as meter fuses.

The multiplier string is mounted on switch S104, the meter-range switch, adjustment of which determines meter resistance. Sensitivity-switch S103, when closed, shunts one position of the multiplier string, effectively increasing the sensitivity of the meter by a factor of 10, since it decreases meter resistance by a factor of 10.

When sensitivity-switch S103 is depressed, the circuit of sensitivity-indicator I105 is also closed. This indicator is primarily to warn the operator if the manual pressure on S103 is decreased sufficiently to allow the sensitivity switch to open, in which case the light will be extinguished.

### 3.2.8 Attenuator Circuit

The attenuator consists of three switched sections and potentiometer R301. One switch section is used for switching between 0 and 400 volts. This consists of R311 through R314. The second section (R307 through R310) is used for switching between 0 and 90 volts. The third section (R303 through R306) is used for switching between 1 and 10 volts. In each section, provision is made for disabling protective relay K102 during the time the unit is being switched. This is accomplished by momentarily applying a positive voltage to the grid of V107B, which insures that K102 will remain closed, thus preventing the action of the protective circuit each time the attenuation is changed.

In the 100's decade, the dumping switch is arranged on the same wafer as the selection switch. In the 10's and 1's decade, however, the requirements of the selecting switches utilize two wafers each, and a third wafer is added in these switches to provide dumping-switch action.

As indicated in Section 3.2.1, one volt is developed across R302. Voltage set by the attenuator is added to this, bucked by the standard-cell reference, and the difference is applied to the amplifier circuitry.

# SECTION 4

# MAINTENANCE

## 4.1 WARNING!

Due to the high-potential of the floating chassis in the Model 301, LETHAL VOLTAGES may be encountered unless normal precautions are taken. Shock hazard may be reduced by connecting a clip lead from the positive output terminal to earth ground.

## 4.2 TUBE AND DIODE MAINTENANCE

In most electronic instruments, the most common sources of failures are tubes, semiconductors and mechanical moving parts.

Tolerances of tubes used in the KIN TEL Model 301 are not critical, providing they are within EIA (RETMA) specifications. As in most precision instruments, the best test for any tube in the Model 301 is made by observing its performance in the circuit, and by substituting a tube known to be good.

Diodes may be checked by measuring voltages as indicated on the schematic diagram, and by accepted conduction testers. Diodes which are paired in a circuit should be replaced by pairs only since, if one diode is replaced, a variance of characteristics may exist between the remaining diode and the replacement. Also, where one diode is found to be shorted, the other may have sustained damage. The safest practice, therefore, is the replacement of both diodes in all instances.

## 4.3 CHOPPER CHECKOUT

The only continuously moving part in the Model 301 is the chopper. The chopper may operate for a period of two years or more without noticeable variation.

The most common evidences of chopper failure are drift and noise. Drift is usually caused by electrolysis within the "stack" of component reeds, stops, terminals and insulating wafers in the base of the chopper. Noise is usually due to defective chopper-breaker points. Choppers are factory-sealed to exclude dust and moisture; therefore, no direct adjustment can be made.

Choppers may be checked by substituting a replacement known to be good, or by testing the suspect chopper in another instrument which is working properly. Occasionally, a chopper will function satisfactorily in one unit and not in another, so a chopper should not be rejected until tried in three or more units.

If a chopper is causing drift, subjecting the chopper to baking at 50° C. (122° F.) for five to ten hours will sometimes restore satisfactory operation.

For more detailed information on choppers, refer to CHOPPER CHECKOUT PROCEDURE (KIN TEL Service Notes Code No. 13-6).

## 4.4 RELAY MAINTENANCE

The only other mechanical moving parts in the Model 301 are the relays. It is advisable to keep contact points burnished for clean contact, and to insure proper relay-drive response by maintaining correct spring tension.

## 4.5 BIAS CELL MAINTENANCE

The Model 301 employs three small mercury cells as bias-voltage sources (BT101, BT102 and BT104). Since the current drain on these cells is negligible, they should operate for their full shelf life.

Occasionally, operating conditions may cause these cells to become coated with a white crystalline deposit. Semi-annual preventive maintenance (more frequently if indicated) is advised, and consists of carefully removing the deposit with a small, stiff-bristled brush and blowing loose particles from the chassis with an air hose.

Cells should be checked for voltage when cleaned, and those having readings of less than 1.2 volts should be replaced, since the extreme flatness of their discharge characteristic will allow them to show almost-perfect readings until they suddenly go dead.

## 4.6 FAN MAINTENANCE

Forced-air cooling is provided the Model 301 by an efficient blower system. Where air conditioning is installed, dust and lint pollution will be at a minimum, and grilles should be cleaned after an approximate 2000 hours of operation. The optimum time schedule for the cleaning of fans and grilles may be determined by periodic visual inspection.

Lubrication of fan motors should be performed at the same time as the cleaning operations. In this regard, it is of prime importance that a proper lubricant be used on these motors. Since the bearings are constructed of a porous material which regulates the flow of lubricant to the motor shaft, oils having a laquer base may, in the presence of heat generated by motor operation, cause bearing pores to clog.

The lubricant recommended for these motors is Shell Oil No. 933, Code L-297. If bearings do become clogged due to improper lubrication, motor operation will be unsatisfactory. Reduction of speed or intermittent operation may occur, progressing to a state of complete inoperation. Since the stability of the instrument is impaired by improper ventilation, steps must be taken to eliminate these conditions. The following procedure should be used to restore motors to original operating condition:

Remove the motor assembly and disassemble it as shown in the exploded view in Figure 4-1.

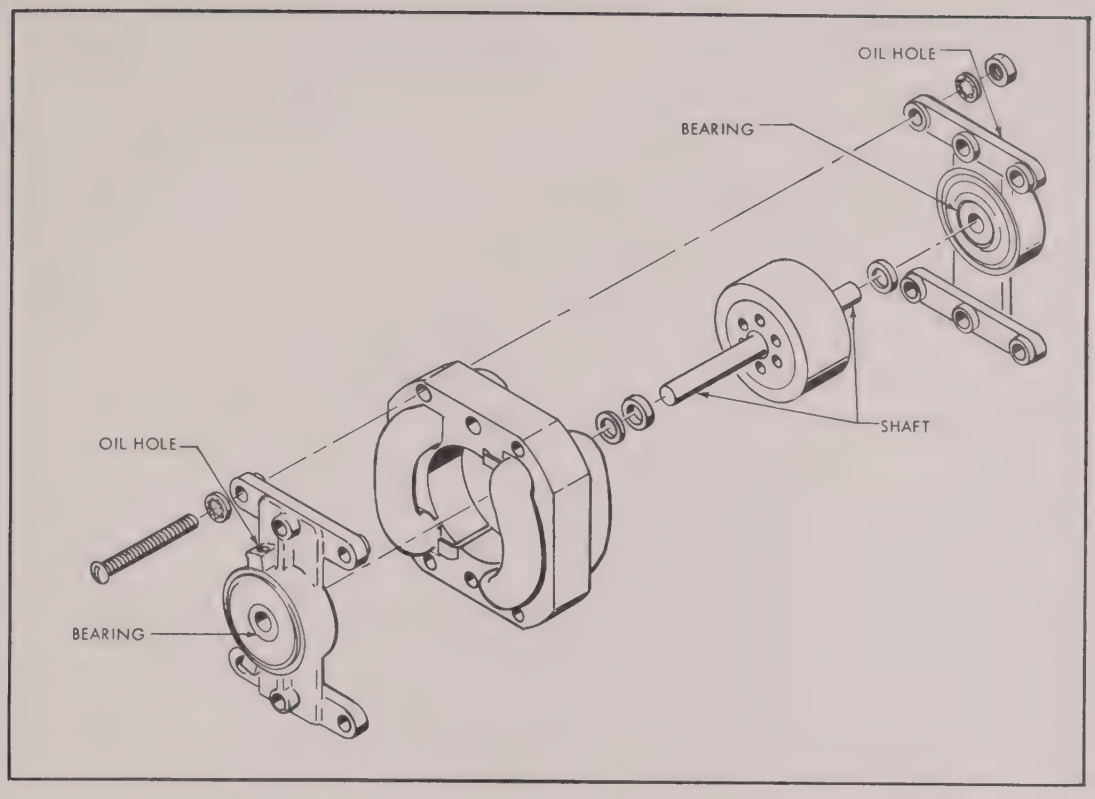



FIGURE 4-1

After the motor is disassembled, the bearings may be cleaned by lightly scraping the surfaces of each bearing to remove the hardened deposit and then soaking the entire bearing assembly in a solvent. Soaking should be continued for at least four hours in order to soften deposits for removal. A stiff brush dipped in the solvent may be used to clean the deposit from the motor shaft.

After soaking has sufficiently softened deposits on the bearings, they should be wiped dry with a clean, lint-free cloth. Care should be taken to remove any remaining deposit from all surfaces. The bearing assembly should then be placed in an oil bath, using the recommended Shell Oil No. 933 Code L-297.

After soaking in the oil bath for two hours, remove the bearing assemblies and wipe off excess oil. The motor may then be reassembled, using the exploded view in Figure 4-1 as a guide.

Care should be exercised in aligning the motor shaft and bearings before the four frame bolts are tightened. Since the bearings are semi-floating, no difficulty should be experienced in assembling them properly.

Subsequent oiling should occur at regular intervals, or after each 2000 hours of operation, using the recommended lubricant. Frequent removal of accumulated dust from the motor by means of compressed air is recommended. As with other maintenance procedures, frequenty of performance will vary with installation conditions, but where no air conditioning is present, weekly checks should be made until a definite schedule can be determined from observation.

## 4.7 METER CHECKOUT

If a meter becomes suspect, the output of the Model 301 should be checked on a meter of known accuracy. If the reading is not the same on both meters, temporarily remove meter-diodes CR107 and CR108, which act as a fuse in the meter circuit, to determine whether a defective diode may be causing the error. The reading should be full scale at a direct input to the meter of 0.048 volts to 0.0515 volts.

## 4.8 TROUBLE SHOOTING

Because relay operation is a function of the protective circuit, it is logical that trouble shooting should begin with the examination of the relay sequence as illustrated in Figure 3-3. Familiarity with this circuitry will be a definite aid to trouble shooting, since the protective circuit must be operative before other component sections will function according to design. Consequently, voltage measurements in most circuits are meaningless unless all relays are closed. If, when the reset indicator lights and switch S102 is closed, relay K101 closes momentarily and then opens after S102 is allowed to open, one of three conditions may be indicated:

1) There is an open filament in V104 or V105, or the associated DC power supply is defective, causing Q101 collector current to drop, thus decreasing plate current of V107B;

2) V107B grid (pin 7) is held beyond cutoff by a high negative voltage across R169 (Such a condition would be caused by too great an input signal to V104B,which would result in excessive drive on CR106, thus decreasing conduction of V107B);

3) Chopper-drive connections are reversed.

If condition number 1) exists, it will be evident upon examination of the associated circuitry.

If number 3) is the cause, simply reversing the chopper-drive leads will eliminate the trouble.

If number 2) is the cause, the next step is to short R160 (V104B grid resistor), thus removing any input signal to the ACA; then operate S102 to close relay K101. If shorting R160 does not restore normal operation of K101, then look for trouble in the circuitry of V107B. If, however, K101 remains closed while R160 is shorted, it is apparent that an excessive

"correcting" signal is being developed between the standard-cell circuitry and the opposing voltage which appears across R302. The reasoning here is that, with R160 shorted, no signal is applied to CR106, and therefore bias on V107B grid should remain normal or below cutoff level.

If operation of V107B circuit is proved to be normal, remove the short from R160.

AC voltage at the junction of CR101-CR102 should now be measured, keeping K101 contacts manually closed while measuring. The correction voltage developed by the ACA which appears at this junction is normally 2.7 volts RMS, and is illustrated in Figure SP-1. If the voltage at this point reads much higher, the DCA is not responding to the correction voltage which the ACA is supplying in order to effect a corrected voltage across R302. Correct voltage (1.0 volts) across R302, when opposed to the standard cell-reference voltage, provides zero input to the ACA, thus restoring the ACA to normal.

## 4.9 VOLTAGE MEASUREMENTS

Normal voltage measurements are given in Figure 4-2 and normal waveforms are illustrated by oscilloscope photos in Figures SP-1 through SP-9 in the appendix.

> NOTE: When checking voltages at tube sockets which are mounted on an etched board, it may be helpful to use tube-socket adapters in order to detect open or intermittent circuits which could develop between tube sockets and etched paths.

## 4.10 PARTS LOCATION

The etched board of the Model 301 is shown in Figure 4-3. It has been illustrated from the back or etch side of the board, with components and their respective connections indicated as they would appear if the etch were translucent. This will expedite location of any point on the board, especially if the schematic diagram is folded open to view in conjunction with the illustration.

Other parts locations are shown by Figures 4-4 and 4-5.

| TUBE NUMBER | PIN 1 | PIN 2 | PIN 3 | PIN 4 | PIN 5 | PIN 6 | PIN 7 | PIN 8 | PIN 9 |
|---|---|---|---|---|---|---|---|---|---|
| V101<br>5Y3 | NC | +560v<br>*6v AC | NP | +100v<br>500 AC | NP | +100v<br>500 AC | NP | +560v<br>*6v AC | NP |
| V102<br>6X4 | -1.7v<br>*320v AC | NC | 0v<br>**3v AC | **3v AC | NC | -10v<br>*320v AC | +380v | NP | NP |
| V103<br>6X4 | -400<br>*640 AC | NC | 0v<br>**3v AC | 0v | NC | -400v<br>*640v AC | +15v | NP | NP |
| V104<br>5751 | +133v | -1.2v | 0v | +5.5v | +5.5v | +127.5v | -1.2v | 0v | 0v HTR. TAP |
| V105<br>6AU6 | -1.3v | 0v | +5.6v | +12.5v | +212.5v | +70v | 0v | NP | NP |
| V106<br>6AU8 | -247v | -254v | 0v | -197.5v<br>*6v AC | -197.5v<br>*6v AC | -247v | -232v | -180v | -20v |
| V107<br>6AU8 | -171v | -112v | 0v | -197v<br>*6v AC | -197v<br>*6v AC | -0.22v | -0.8v | +43v | +2.5v<br>(±15%) |
| V108<br>6B66 | NC<br>*6v AC | 0v | +0.34v | NP | -20v | NP | 0v<br>*6v AC | +105v | (Plate Cap) +580v |
| V109<br>6AW8 | 0v | -1.3v | +75v | 0v<br>*6v AC | 0v<br>*6v AC | 0v | -1.2v | +28v | +155v |

* AC VOLTAGE MEASURED FROM PIN OF SAME TUBE WHICH SHOWS SAME READING

** AC VOLTAGE MEASURED TO CHASSIS

NC = NO CONNECTION

NP = NO PIN

VOLTAGE MEASUREMENT
FIGURE 4-2

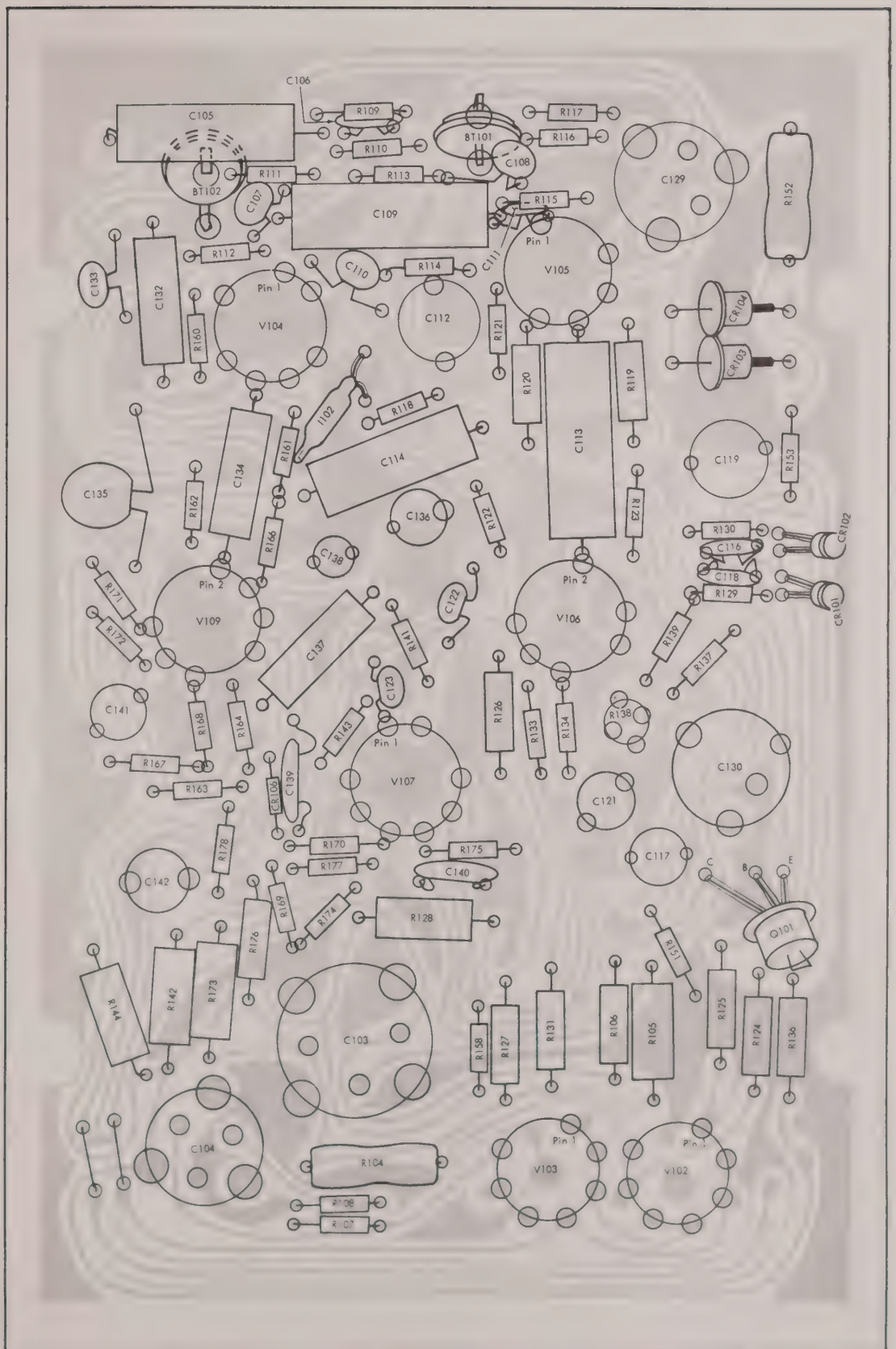
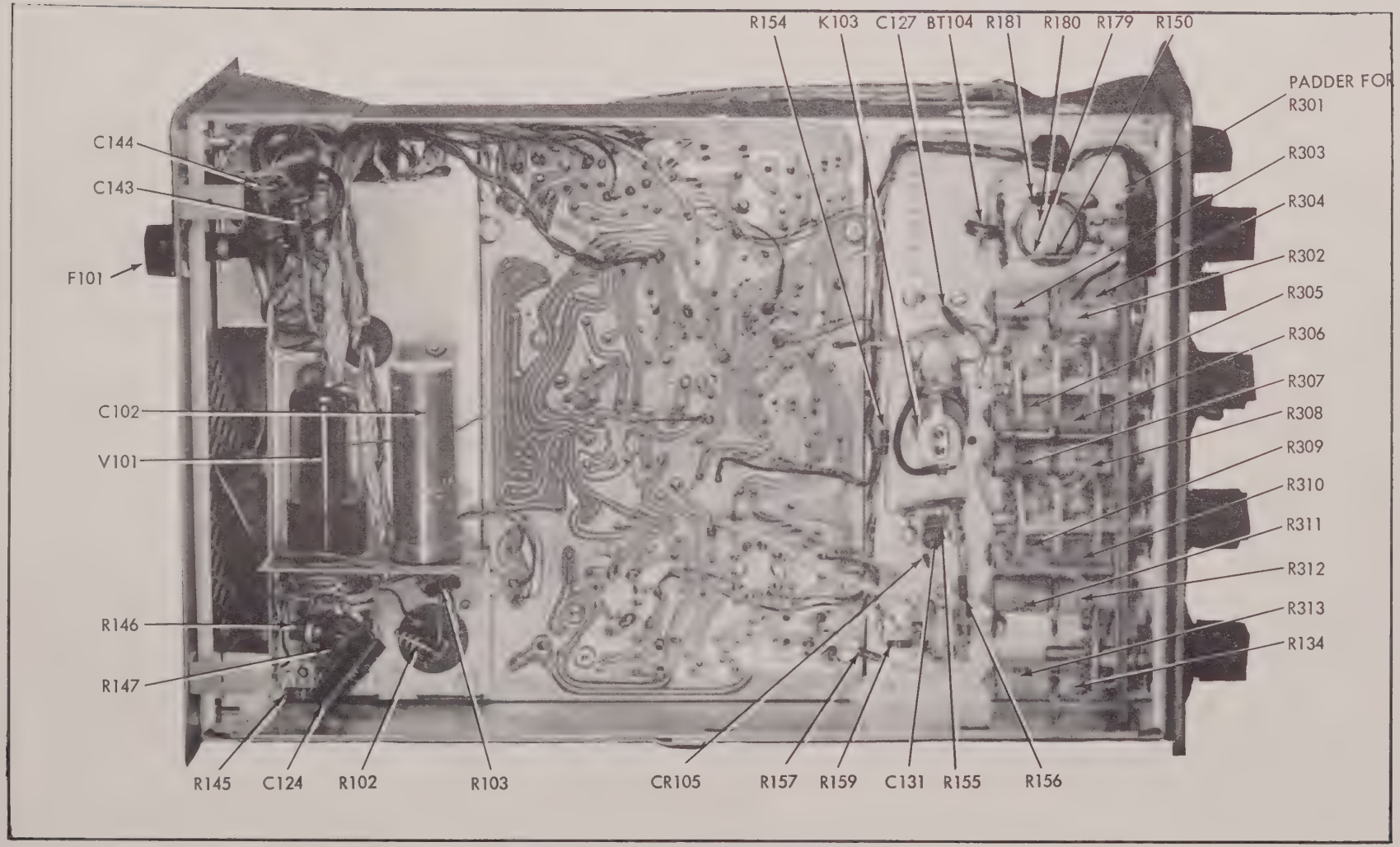
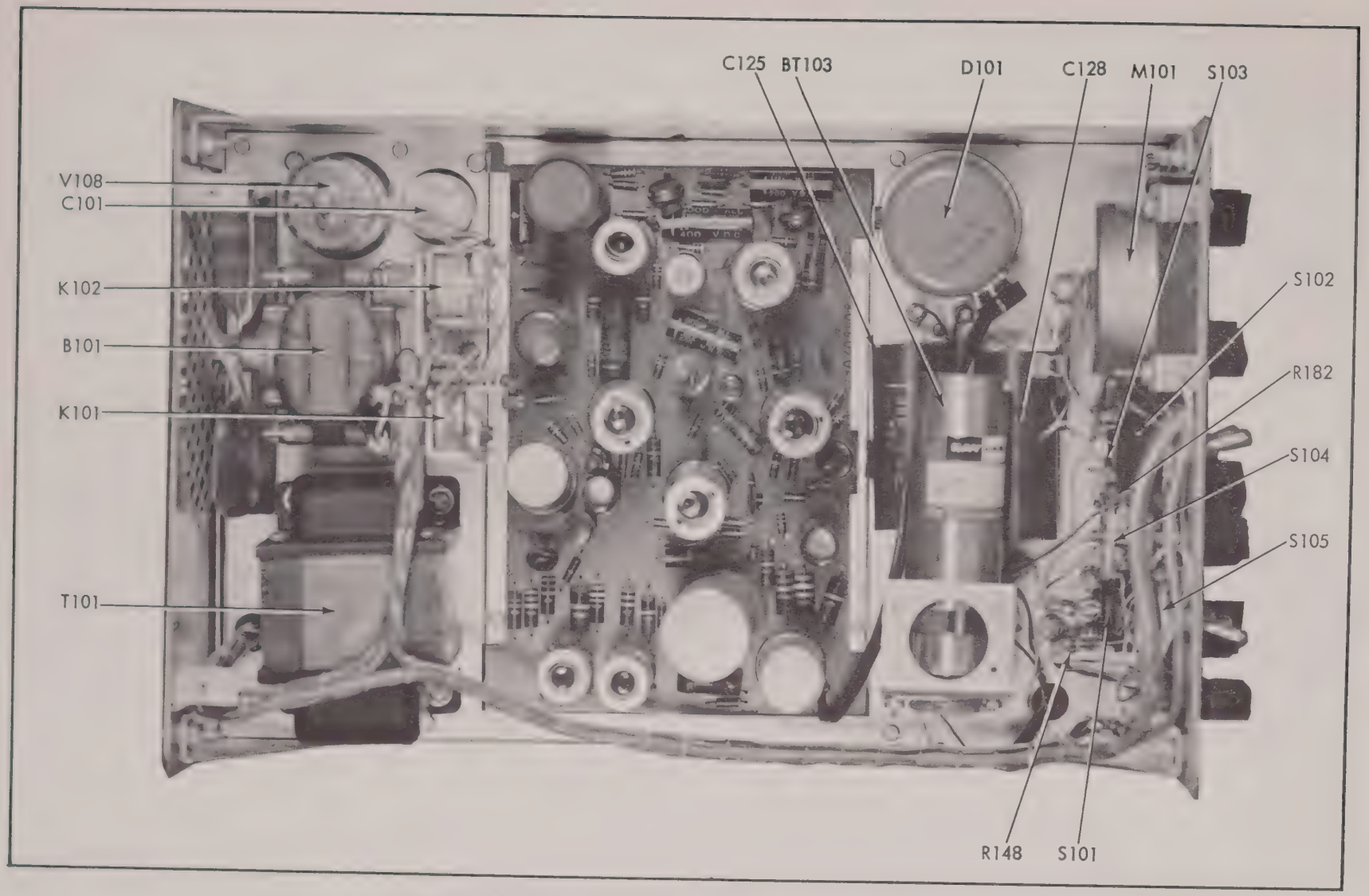



FIGURE 4-3 PARTS LOCATION ON ETCHED BOARD




DC VOLTAGE STANDARD MODEL 301
RIGHT SIDE ( ATTENUATOR & UNREG. SUPPLY)

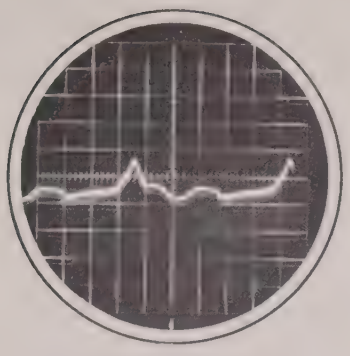
FIGURE 4-4




DC VOLTAGE STANDARD MODEL 301 (LEFT SIDE)
FIGURE 4-5

ADDITIONAL PARTS NOT VISIBLE IN PARTS - LOCATION PHOTOS

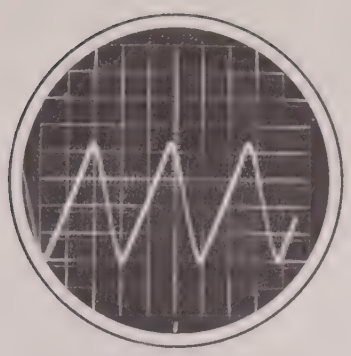
R101 is located between AC-ON Switch S105 and AC-ON Indicator I101.
R135 is located between Reset-Switch S102 and Reset-Indicator I103.
R149 is located on the back of DC-ON Switch S101.
R183, R184 and R185 are located on Meter-Range Switch S104.
R186 is located between Sensitivity-X-10 Switch S103 and Sensitivity-Indicator I105.



DC BALANCE MEASURED AT THE JUNCTION OF CR101/CR102

SENSITIVITY: 10 VOLTS PER CENTIMETER
SWEEP TIME: 2 MILLISECONDS

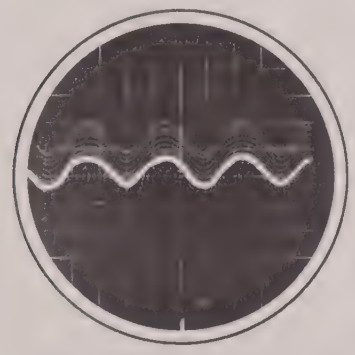
FIGURE SP-1



NORMAL RIPPLE MEASURED AT THE JUNCTION OF R104/C103A

SENSITIVITY: 1 VOLT PER CENTIMETER
SWEEP TIME: 2 MILLISECONDS

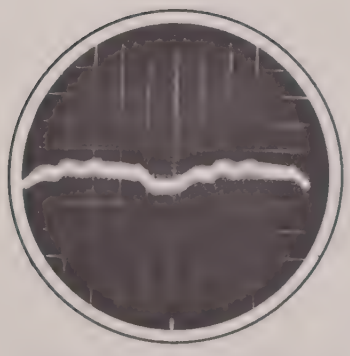
FIGURE SP-2



NORMAL RIPPLE MEASURED AT THE JUNCTION OF R105/R106/C103B

SENSITIVITY: 10 MV PER CENTIMETER
SWEEP TIME: 2 MILLISECONDS

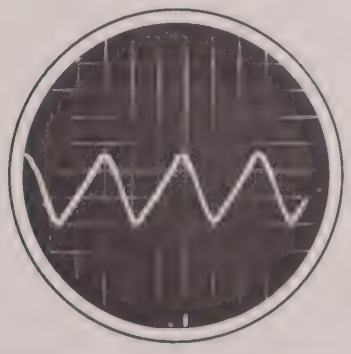
FIGURE SP-3



NORMAL RIPPLE MEASURED AT THE JUNCTION OF R106/C103C

SENSITIVITY: 2 MV PER CENTIMETER
SWEEP TIME: 2 MILLISECONDS

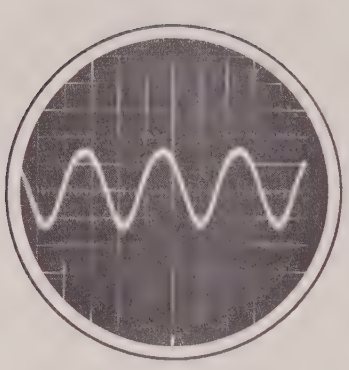
FIGURE SP-4



NORMAL RIPPLE MEASURED AT THE JUNCTION OF CR103/C129A (PIN 4 OF V105)

SENSITIVITY: .5 VOLTS PER CENTIMETER
SWEEP TIME: 2 MILLISECONDS

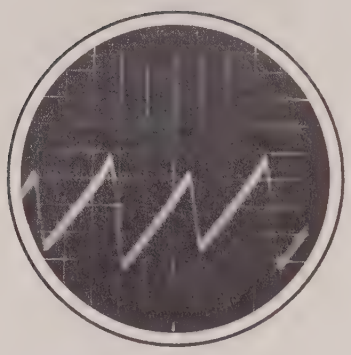
FIGURE SP-5



NORMAL RIPPLE MEASURED AT PIN 3 OF V105

SENSITIVITY: 20 MV PER CENTIMETER
SWEEP TIME: 2 MILLISECONDS

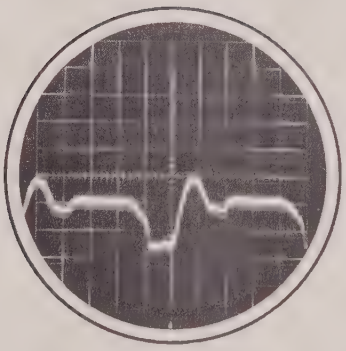
FIGURE SP-6



NORMAL RIPPLE MEASURED AT THE JUNCTION OF R102/R103

SENSITIVITY: .1 VOLT PER CENTIMETER
SWEEP TIME: 2 MILLISECONDS

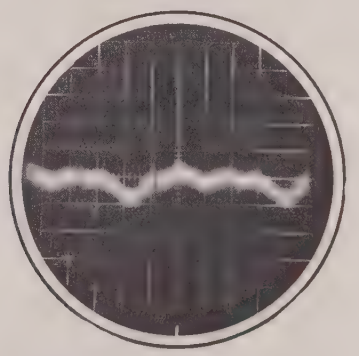
FIGURE SP-7



NORMAL FEEDBACK WAVEFORM MEASURED AT THE JUNCTION OF R159/C136

SENSITIVITY: .1 VOLT PER CENTIMETER
SWEEP TIME: 2 MILLISECONDS

FIGURE SP-8



NORMAL OUTPUT WAVEFORM OF AVERAGE INSTRUMENT HAVING AN APPROXIMATE 40 μv NOISE LEVEL

SENSITIVITY: 20 MV PER CENTIMETER
SWEEP TIME: 2 MILLISECONDS

NOTE: THIS MEASUREMENT OBTAINED THROUGH HP400D WHICH WAS SET IN THE .001 POSITION, AND CONNECTED TO THE OUTPUT TERMINALS OF THE MODEL 301 UNDER TEST

FIGURE SP-9

NOTE: IN CHECKING AN INSTRUMENT AGAINST WAVEFORMS, RELAY K103 MUST BE CLOSED. IF PROTECTIVE CIRCUIT IS BREAKING CONTACT, K103 MAY BE HELD CLOSED MANUALLY UNTIL WAVEFORM IS MEASURED.

MEASUREMENTS MADE WITH HEWLETT-PACKARD HP130A OSCILLOSCOPE, WITH DIAL SCALE FULLY ILLUMINATED, AND WITH INTENSITY RESTRICTED AS MUCH AS POSSIBLE FOR CLARITY OF PHOTOGRAPH.

# INSTRUMENT WARRANTY

ALL KIN TEL instruments are unconditionally guaranteed for one year against defects in workmanship or material, with the exception of vacuum tubes, diodes, batteries and fuses. Tubes and diodes carry the manufacturer's standard 90-day warranty.

When difficulty is encountered during the warranty period, the customer should contact the KIN TEL field-engineering representative in his area. The field engineer will advise the customer of the steps that will be taken to authorize and expedite necessary repairs.

For customer convenience, service departments are maintained throughout the United States by KIN TEL field-engineering representatives, where service is available both during and after the warranty period. Instruments that must be repaired during the first 90 days of use where no service facility exists can be shipped to the factory collect, and freight will be paid by KIN TEL in both directions. Equipment that has been in use for more than 90 days but less than one year will be repaired free of charge at our plant, provided that freight is paid by the customer in both directions.

Incorporated in the applicable technical manual for each instrument is a perforated, removable "INDIVIDUAL INSTRUMENT RECORD." When returning equipment for repairs, this record should be filled out by the technical personnel responsible for the operation and maintenance of the equipment. The record should be placed in a protective envelope and accompany the equipment during repairs.

5725 Kearny Villa Road KIN TEL San Diego 11, California
A DIVISION OF
COHU ELECTRONICS, INC

# INDIVIDUAL INSTRUMENT RECORD AND AUTHORIZATION FOR REPAIR

MODEL NO. _____ SERIAL NO. _____

PURCHASED FROM: _____ DATE PURCHASED: _____ CUSTOMER P. O. NO. _____

SYMPTOMS NOTED: _____

_____

_____

(If application entails environmental or other specific ambient conditions which may affect operation, please describe)*

REPAIR AUTHORIZED BY: (Person, Company and Date)** _____

SPECIFIC REPAIRS REQUESTED: _____

_____

(If additional papers accompany this RECORD, please staple to this sheet. Back of this sheet may be used for further data)

SHIPPING INSTRUCTIONS FOR RETURN OF INSTRUMENT: _____

BALANCE OF THIS FORM TO BE COMPLETED BY REPAIR PERSONNEL ONLY

REPAIR DATE: _____ REPAIR ORDER NO. _____ TECHNICIAN: _____

REPAIRS PERFORMED (Including any discrepancies noted): _____

_____

_____

_____

*If classified information affects repair status, state contact for KIN TEL Security Department.

**Repair must be authorized by KIN TEL or representative personnel and this form returned with instrument.

# DC VOLTAGE STANDARD

## MODEL 301

## PARTS LIST

| | CAPACITORS | KIN TEL PARTS NO. |
|---|---|---|
| * C101 | 40 µf 450 V Electro Can | 0501124 |
| * C102 | 40 µf 450 V Electro Can | 0501124 |
| * C103 | (A/B/C) 20/40/80 µf 450 V Mallory PFPF | 0510022 |
| * C104 | (A/B/C) 10/10/20 µf 450 V Mallory PFPB | 0510021 |
| * C105 | .1 µf 200 V Epoxy Axial | 0610017-27 |
| C106 | 150 µµf 500 V Ceramic Disc | 0401025 |
| C107 | 100 µµf 500 V Ceramic Disc | 0401022 |
| C108 | .003 µf 500 V Ceramic Disc | 0403741 |
| * C109 | .1 µf 400 V Epoxy Axial | 0610018-27 |
| C110 | 50 µµf 500 V Ceramic Disc | 0401016 |
| C111 | 100 µµf 500 V Ceramic Disc | 0401022 |
| * C112 | 8 µf 150 V Mallory PC Tubular 11/6" dia. X 1 3/8 | 0510023 |
| * C113 | .047 µf 600 V Epoxy Axial | 0610019-23 |
| * C114 | .022 µf 600 V Epoxy Axial | 0610019-19 |
| C115 | | |
| C116 | .01 µf 500 V Ceramic Disc | 0401056 |
| * C117 | .047 µf 400 V Epoxy PC | 0610014-23 |
| C118 | .01 µf 500 V Ceramic Disc | 0401056 |
| * C119 | .47 µf 400 V Epoxy PC | 0610014-35 |
| C120 | | |
| * C121 | .047 µf 400 V Epoxy PC | 0610014-23 |
| C122 | .001 µf 500 V Ceramic Disc | 0401046 |
| C123 | .001 µf 500 V Ceramic Disc | 0401046 |
| * C124 | .1 µf 200 V Epoxy Axial | 0610017-27 |
| * C125 | 1. µf 600 V Epoxy Axial | 0610019-39 |
| C126 | | |
| C127 | .01 µf 500 V Ceramic Disc | 0401056 |
| * C128 | 1. µf 600 V Epoxy Axial | 0610019-39 |
| * C129 | (A/B) 1000/1000 µf 15 V Aero E 92B30 | 0510007 |
| * C130 | 1000 µf 6 V Mallory PWP B 1 X 2 can | 0510024 |
| C131 | .002 µf 500 V Ceramic Disc | 0401048 |
| * C132 | .01 µf 200 V Epoxy Axial | 0610017-15 |
| C133 | 50 µµf 500 V Ceramic Disc | 0401016 |
| * C134 | .01 µf 400 V Epoxy Axial | 0610018-15 |
| C135 | .003 µf 500 V Ceramic Disc | 0403741 |
| * C136 | .1 µf 400 V Epoxy PC | 0610014-27 |
| * C137 | .01 µf 400 V Epoxy Axial | 0610018-15 |
| * C138 | .01 µf 400 V Epoxy PC | 0610014-15 |
| C139 | .02 µf 500 V Ceramic Disc | 0401058 |
| C140 | .02 µf 500 V Ceramic Disc | 0401058 |
| * C141 | .1 µf 400 V Epoxy PC | 0610014-27 |
| * C142 | .1 µf 400 V Epoxy PC | 0610014-27 |
| * C143 | .01 µf 600 V Epoxy Axial | 0610019-15 |
| * C144 | .01 µf 600 V Epoxy Axial | 0610019-15 |

| | RESISTORS | |
|---|---|---|
| R101 | 100K 1 W 5% | 0310031-104 |
| R102 | 330K 1 W 5% | 0310031-334 |
| R103 | 330K 1 W 5% | 0310031-334 |
| R104 | 500 Ω 5 W W.W. 5% | 5101995 |
| R105 | 10K 2 W 5% | 4501793 |
| R106 | 39K 1 W 5% | 0310031-393 |
| R107 | 470 Ω 1/2 W 5% | 0310030-471 |
| R108 | 470 Ω 1/2 W 5% | 0310030-471 |
| R109 | 1K 1/2 W 5% | 0310030-102 |
| R110 | 1 Meg 1/2 W 5% | 0310030-105 |
| R111 | 10 Meg 1/2 W 5% | 0310030-106 |
| R112 | 220K 1/2 W 5% | 0310030-224 |
| R113 | 5.6K 1/2 W 5% | 0310030-562 |
| R114 | 470K 1/2 W 5% | 0310030-474 |
| R115 | 1.5 Meg 1/2 W 5% | 0310030-155 |
| R116 | 1 Meg 1/2 W 5% | 0310030-105 |
| R117 | 330K 1/2 W 5% | 0310030-334 |
| R118 | 4.7 Meg 1/2 W 5% | 0310030-475 |
| R119 | 82K 1 W 5% | 0310031-823 |
| R120 | 120K 1 W 5% | 0310031-124 |
| R121 | 47K 1/2 W 5% | 0310030-473 |
| R122 | 270K 1/2 W 5% | 0310030-274 |

* Recommended Spare

# DC VOLTAGE STANDARD

## MODEL 301

### PARTS LIST (cont'd)

| | RESISTORS | KIN TEL PARTS NO. |
|---|---|---|
| R123 | 6.8 Meg 1/2 W 5% | 0310030-685 |
| R124 | 330K 1 W 5% | 0310031-334 |
| R125 | 330K 1 W 5% | 0310031-334 |
| R126 | 82K 1 W 5% | 0310031-823 |
| R127 | 100K 1 W 5% | 0310031-104 |
| R128 | 27K 2 W 5% | 4501798 |
| R129 | 33K 1/2 W 5% | 0310030-333 |
| R130 | 33K 1/2 W 5% | 0310030-333 |
| R131 | 330K 1 W 5% | 0310031-334 |
| R132 | | |
| R133 | 56K 1/2 W 5% | 0310030-563 |
| R134 | 6.8 Meg 1/2 W 5% | 0310030-685 |
| R135 | 100 K 1 W 5% | 0310031-104 |
| R136 | 56K 1 W 5% | 0310031-563 |
| R137 | 470 1/2 W 5% | 0310030-474 |
| * R138 | 10 K 1/4 W 20% Lin Tap Pot Allen-Bradley Type F | 5010179-8 |
| R139 | 47K 1/2 W 5% | 0310030-473 |
| R140 | | |
| R141 | 2.2 Meg 1/2 W 5% | 0310030-225 |
| R142 | 39K 2 W 5% | 4501800 |
| R143 | 560 Ω 1/2 W 5% | 0310030-561 |
| R144 | 82K 2 W 5% | 4501804 |
| R145 | 100 Ω 1 W 5% | 0310031-101 |
| R146 | 100K 2 W 5% | 0310032-104 |
| R147 | 39K 1 W 5% | 0310031-393 |
| R148 | 100K 1 W 5% | 0310031-104 |
| R149 | 10 Ω 1/2 W 5% | 0310030-100 |
| R150 | 220 Ω 1/2 W 5% | 0310030-221 |
| R151 | 1 Meg 1/2 W 5% | 0310030-105 |
| R152 | 4Ω 5W W.W. 5% | 5101975 |
| R153 | 82 Ω 1/2 W 5% | 0310030-820 |
| R154 | 220K 1/2 W 5% | 0310030-224 |
| R155 | 330K 1/2 W 5% | 0310030-334 |
| R156 | 22K 1/2 W 5% | 0310030-223 |
| R157 | 1000 Ω 1/2 W 5% | 0310030-102 |
| R158 | 1 Meg 1/2 W 5% | 0310030-105 |

| | RESISTORS | KIN TEL PARTS NO. |
|---|---|---|
| R159 | 22K 1/2 W 5% | 0310030-223 |
| R160 | 10 Meg 1/2 W 5% | 0310030-106 |
| R161 | 220K 1/2 W 5% | 0310030-224 |
| R162 | 3.3 Meg 1/2 W 5% | 0310030-335 |
| R163 | 10 Meg 1/2 W 5% | 0310030-106 |
| R164 | 100K 1/2 W 5% | 0310030-104 |
| R165 | | |
| R166 | 220K 1/2 W 5% | 0310030-224 |
| R167 | 3.3 Meg 1/2 W 5% | 0310030-335 |
| R168 | 3.3 Meg 1/2 W 5% | 0310030-335 |
| R169 | 10 Meg 1/2 W 5% | 0310030-106 |
| R170 | 1 Meg 1/2 W 5% | 0310030-105 |
| R171 | 220K 1/2 W 5% | 0310030-224 |
| R172 | 3.3 Meg 1/2 W 5% | 0310030-335 |
| R173 | 82K 2 W 5% | 4501804 |
| R174 | 15K 1/2 W 5% | 0310030-153 |
| R175 | 5.6K 1/2 W 5% | 0310030-562 |
| R176 | 22K 1 W 5% | 0310031-223 |
| R177 | 10 Meg 1/2 W 5% | 0310030-106 |
| R178 | 470 Ω 1/2 W 5% | 0310030-471 |
| R179 | 10K 1/2 W 1% | 4703412 |
| * R180 | 5K 2W Pot Allen-Bradley 1/2" shaft | 5010053-7 |
| * R181 | 800K 1/2 W 1% | 4703477 |
| * R182 | 18 Meg 1 W 1% | 4803544 |
| * R183 | 1.8 Meg 1/2 W 1% | 4703499 |
| * R184 | 180K 1/2 W 0.5% | 4705395 |
| * R185 | 18K 1/2 W 1% | 4710004 |
| * R186 | 100K 1 W 5% | 0310031-104 |
| * R301 | 1000 Ω Pot General Radio Type 971K | 5010062 |
| Δ R302 | 1K 1 W .1% | 5204364 |
| Δ R303 | 1K 1 W .1% | 5204364 |
| Δ R304 | 2K 1 W .1% | 5204367 |
| Δ R305 | 2K 1 W .1% | 5204367 |
| Δ R306 | 4K 1 W .1% | 5204368 |
| Δ R307 | 10K 1 W .1% | 5204372 |

* Recommended Spare

Δ Part of Precision Attenuator; Individual Value is Nominal

DC VOLTAGE STANDARD

MODEL 301

PARTS LIST (cont'd)

| | RESISTORS | KIN TEL PARTS NO. |
|---|---|---|
| ▲ R308 | 20K 1 W .1% | 5204374 |
| ▲ R309 | 20K 1 W .1% | 5204377 |
| ▲ R310 | 40K 1 W .1% | 5204377 |
| ▲ R311 | 100K 1 W .1% | 5204384 |
| ▲ R312 | 100K 1 W .1% | 5204384 |
| ▲ R313 | 100K 1 W .1% | 5204384 |
| R314 | 100K 1 W .1% | 5204384 |

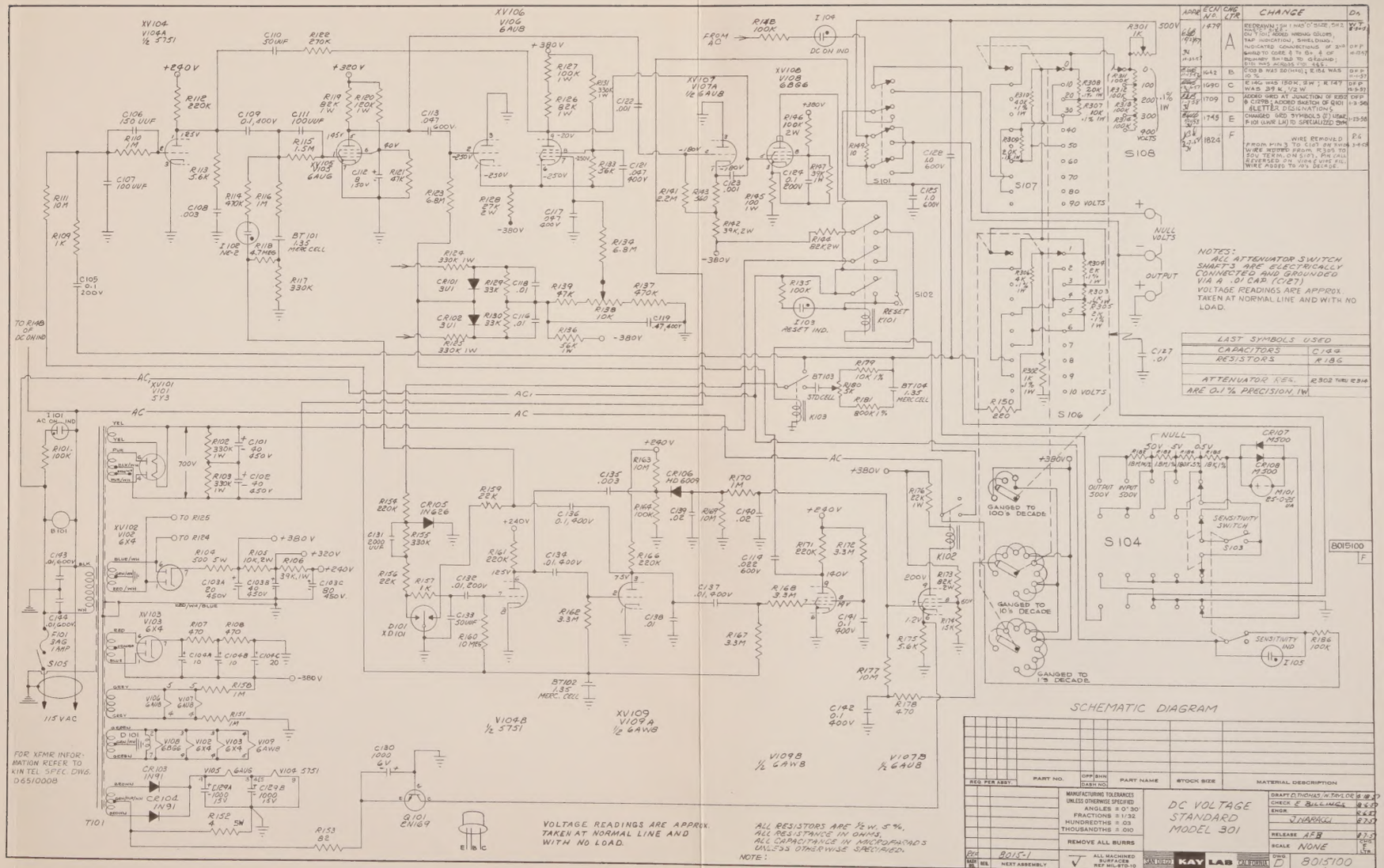
| | MISCELLANEOUS | |
|---|---|---|
| B101 | Fan Motor | 3107739 |
| BT101 | Mercury Cell 1.35 V | 1804158 |
| BT102 | Mercury Cell 1.35 V | 1804158 |
| BT103 | Standard Cell | 0200220 |
| BT104 | Mercury Cell 1.35 V | 1804158 |
| *CR101 | Diode 3U1 | 3506774-7 |
| *CR102 | Diode 3U1 | 3506774-7 |
| *CR103 | Diode 1N91 | 3506751-2 |
| *CR104 | Diode 1N91 | 3506751-2 |
| *CR105 | Diode 1N626 | 3510006 |
| *CR106 | Diode HD 6009 | 3507247 |
| *CR107 | Diode M500 Sarkes-Tarzian | 3510005 |
| *CR108 | Diode M500 Sarkes-Tarzian | 3510005 |
| *D101 | Converter Brown SS15374KA | 6310002 |
| I101 | Indicator Light Eldema 1EG | 1710036 |
| I102 | Light NE2 | 1704151 |
| I103 | Indicator Light Eldema 1EG | 1710036 |
| I104 | Indicator Light Eldema 1EG | 1710036 |
| I105 | Indicator Light Eldema 1EG | 1710036 |
| * K101 | Relay 5A (Leach MG-3C) 115 VA | 3710002 |
| * K102 | Relay 10K DC SPDT Series 200 | 3701285 |
| * K103 | Relay 10K DC SPDT Series 200 | 3701285 |

| | MISCELLANEOUS | KIN TEL PARTS NO. |
|---|---|---|
| M101 | Meter Special Design | 3010004 |
| *Q101 | Transistor GE 2N169 | 7210003 |
| S101 | Switch 4-PDT Cutler-Hammer 7691 | 6110003 |
| S102 | Switch DPDT Momentary Carling 6 GL 63-73 | 6110004 |
| S103 | Switch DPDT Momentary Carling 6 GL 63-73 | 6110004 |
| S104 | Switch Centralab PA 2011 | 6210009 |
| S105 | Switch Bat-toggle 3A SPST | 6103563 |
| S106, S107, S108 | Assembly only | 8015015-1 |
| T101 | Transformer Power UTC PA-2384 SPL301A | 6510008 |

| | TUBES | |
|---|---|---|
| *V101 | 5Y3GT | 7002726 |
| *V102 | 6X4 | 7002786 |
| *V103 | 6X4 | 7002786 |
| *V104 | 5751 | 7302812 |
| *V105 | 6AU6 | 7002748 |
| *V106 | 6AU8 | 7007118 |
| *V107 | 6AU8 | 7007118 |
| *V108 | 6BG6G | 7002759 |
| *V109 | 6AW8 | 7007419 |

* Recommended Spare

▲ Part of Precision Attenuator; Individual Value is Nominal


XV104 V104A ½ 5751
XV106 V106 6AU8
XV107 V107A ½ 6AU8
XV108 V108 6BA6
XV101 V101 5Y3
XV102 V102 6X4
XV103 V103 6X4
XV105 V105 6AU8
XV109 V109A ½ 6AW8
V104B ½ 5751
V109B ½ 6AW8
V107B ½ 6AU8
+380V
+240V
+320V
-380V
-230V
-250V
-180V
+90V
-90V
700V
115 V AC
AC
AC1
TO R148 OF DC ON IND
TO R125
TO R124
FROM AC
DC ON IND
AC ON IND
RESET IND.
STD CELL
MERC CELL
NE-2
XD101
Q101 2N169
CR101 3U1
CR102 3U1
CR103 1N91
CR104 1N91
CR105 IN626
CR106 HD6009
CR107 M500
CR108 M500
M101 85-052
S101
S102
S103
S104
S105
S106
S107
S108
K101
K102
K103
NULL VOLTS
OUTPUT
SENSITIVITY SWITCH
GANGED TO 100's DECADE
GANGED TO 10's DECADE
GANGED TO 1's DECADE
FOR XFMR INFORMATION REFER TO KINTEL SPEC. DWG. 06510008
VOLTAGE READINGS ARE APPROX. TAKEN AT NORMAL LINE AND WITH NO LOAD.
ALL RESISTORS ARE ½ W, 5%, ALL RESISTANCE IN OHMS, ALL CAPACITANCE IN MICROFDACAS UNLESS OTHERWISE SPECIFIED.
NOTE:
NOTES: ALL ATTENUATOR SWITCH SHAFTS ARE ELECTRICALLY CONNECTED AND GROUNDED VIA A .01 CAP. (C127) VOLTAGE READINGS ARE APPROX. TAKEN AT NORMAL LINE AND WITH NO LOAD.
LAST SYMBOLS USED
CAPACITORS C168
RESISTORS R186
ATTENUATOR RES. R302 THRU R314 ARE 0.1% PRECISION, 1W
SCHEMATIC DIAGRAM
DC VOLTAGE STANDARD MODEL 301
8015100
8015-1
KAY LAB
SAN DIEGO CALIFORNIA